



# Programming with Android: Data management

**Luca Bedogni**

**Marco Di Felice**

**Dipartimento di Informatica: Scienza e Ingegneria**

**Università di Bologna**



# Data: **outline**

- ❖ Data Management in Android
  - ❖ Preferences
  - ❖ Text Files
  - ❖ XML Files
  - ❖ SQLite Database
  - ❖ Content Provider



# Managing Data

**Preferences:** Key/Value pairs of data

**Direct File I/O:** Read/write files onboard or on SD cards. Remember to request permission for writing, for instance, on SD card

**Database Tables:** SQL Lite

**Application Direct Access:** Read only access from res assets/raw directories

**Increase functionality:**

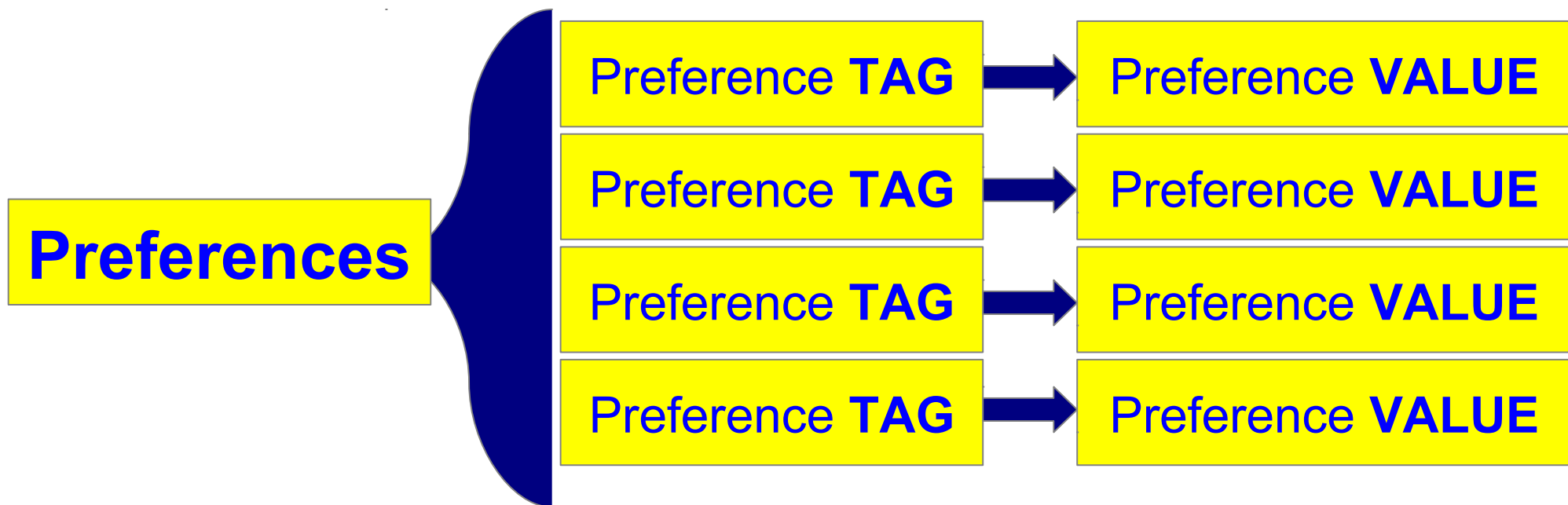
*Content Providers:* expose data to other applications

*Services:* background processes that run detached from any view



# Preference system

- ❖ Preferences are a convenient way to store configuration parameters
- ❖ Structured with a key-value mode





# Preferences types

- ❖ Preferences could be either private or shared
  - Shared means that other applications could potentially read such preferences
  - Private means that they could be restricted at
    - Application level
    - Activity level



# Preferences types

## ❖ Shared preferences

```
getSharedPreferences(String name, Context.MODE_WORLD_READABLE);  
getSharedPreferences(String name, Context.MODE_WORLD_WRITABLE);
```

## ❖ Private at application level

```
getSharedPreferences(String name, Context.MODE_PRIVATE);
```

## ❖ Private at activity level

```
getPreferences(int mode);
```



# Preference example

```
public void onCreate(Bundle savedInstanceState) {  
    Super.onCreate(savedInstanceState);  
    setContentView(R.layout.main);  
    SharedPreferences pref = getSharedPreferences(MY_TAG,  
        Context.MODE_PRIVATE);  
    String myData = pref.getString(MY_KEY, "No pref");  
    TextView myView = (TextView)findViewById(R.id.myTextView);  
    myView.setText(myData);  
}
```



# Preferences editor

- ❖ How to edit preferences?
- ❖ You need to get a `SharedPreferences.Editor`

```
SharedPreferences.Editor editor = pref.edit();  
editor.putString("mydata", et.getText().toString());  
editor.commit();
```

- ❖ Be sure to commit operations at the end





# Preferences screens

- ❖ Could be defined via XML
- ❖ Some specializations to ease the process
  - CheckBoxPreference
  - EditTextPreference
  - ListPreference
  - RingtonePreference
- ❖ Create a class that extends PreferenceActivity and call

```
addPreferencesFromResource(R.xml.mypreferences);
```



# The Android **FileSystem**

- ❖ Linux architecture
- ❖ User privileges
  - Quite limited
- ❖ Onboard data
  - Application's reserved data
- ❖ External data
  - SD card (/mnt/sdcard)



# File I/O

## ❖ Onboard

- Write to a designated place for each application
- **Where?** /data/data/<package>/files
- **How?** Use standard java I/O classes

## ❖ SD card

- **Where?** Environment.getExternalStorageDirectory()
- **How?** Use standard java I/O classes
- **Permissions?** android.permission.WRITE\_EXTERNAL\_STORAGE



# Raw Text Files: **how?**

## ❖ Raw Text File

- ❖ Place it under res/raw/ directory
- ❖ Fill it with the text you like
- ❖ Cannot edit it
- ❖ Populate a TextView with it's content inside the code

```
TextView tv = (TextView)findViewById(R.id.tv_main);  
tv.setText(streamToString(R.raw.myfile));
```



# streamToString()

```
private String streamToString(int id) {
    InputStream file = getResources().openRawResource(id);
    StringBuffer data = new StringBuffer();
    DataInputStream dataIO = new DataInputStream(file);
    String line = null;
    try {
        while ((line = dataIO.readLine()) != null)
            data.append(line + "\n");
        dataIO.close();
        file.close();
    } catch (IOException e) { }
    return data.toString();
}
```



# XML Files: **how?**

## ❖ XML File

- ❖ Place it under res/xml/ directory

- ❖ Start the file with

  - `<?xml version="1.0" encoding="utf-8"?>`

- ❖ Add whatever you want with `<mytag>value</mytag>`



# XML Files: **example**

- ❖ We want to visualize all the grades of this class
- ❖ Our XML file is like this:

```
<student  
  name="Student's name"  
  class="Laboratorio di Applicazioni Mobili"  
  year="2012"  
  grade="30L" />
```



# XML Files: code example

```
XmlResourceParser grades = getResources().getXml(R.xml.myxmlfile);
LinearLayout ll = (LinearLayout)findViewById(R.id.myLL); int tag = -1;
while (tag != XmlResourceParser.END_DOCUMENT) {
    if (tag == XmlResourceParser.START_TAG) {
        String name = grades.getName();
        if (name.equals("student")) {
            TextView tv = new TextView(this);
            LayoutParams lp = new LayoutParams(LayoutParams.FILL_PARENT,
                LayoutParams.WRAP_CONTENT);
            tv.setLayoutParams(lp);
            String toWrite = grades.getAttributeValue(null, "name") + ...;
            tv.setText(toWrite); ll.addView(tv);
        }
    }
    try { tag = grades.next(); } catch (Exception e) {}
}
```





# SQLite

## General purpose solution

- Lightweight database based on SQL

## Standard SQL syntax

```
SELECT name FROM table WHERE name = "Luca"
```

Android gives a standard interface to SQL tables of other apps

For application tables no content providers are needed



# SQLite: how?

- ❖ A database to store information
- ❖ Useful for structured informations
- ❖ Create a DBHelper which extends SQLiteOpenHelper
- ❖ Fill it with methods for managing the database
  - Better to use constants like
    - TABLE\_GRADES
    - COLUMN\_NAME
    - .....



# SQLite: **example**

- ❖ Our database will look like this:
  - ❖ grade table:
    - ❖ id: integer, primary key, auto increment
    - ❖ firstName: text, not null
    - ❖ lastName: text, not null
    - ❖ class: text, not null
    - ❖ grade: integer, not null



# SQLite: **better to use constants**

- ❖ Useful for query definition
- ❖ Our constants?

```
private static final String DB_NAME = "grades.db";  
private static final int DB_VERSION = 1;  
public static final String TABLE_GRADES = "grades";  
public static final String COL_ID = "id";  
public static final String COL_FIRSTNAME = "firstName";  
public static final String COL_LASTNAME = "lastName";  
public static final String COL_CLASS = "class";  
public static final String COL_GRADE = "grade";
```



# SQLite: creation code

## ❖ Constructor: call the superconstructor

```
Public mySQLiteHelper(Context context) {  
    super(context, DB_NAME, null, DB_VERSION);  
}
```

## ❖ onCreate(SQLiteDatabase db): create the tables

```
String sql_grade = "create table " + TABLE_GRADES + "( " +  
    COL_ID + " integer primary key autoincrement, " +  
    COL_FIRSTNAME + " text not null, " +  
    COL_LASTNAME + " text not null, " +  
    COL_CLASS + " text not null, " +  
    COL_GRADE + " text not null ");";  
db.execSQL(sql_grade);
```



# SQLite: insert code

## ❖ Create a public method, like insertDb(...)

```
mySQLiteHelper sql = new mySQLiteHelper(InsertActivity.this);
SQLiteDatabase db = mySQLiteHelper.getWritableDatabase();
ContentValues cv = new ContentValues();
cv.put(mySQLiteHelper.COL_FIRSTNAME, firstName);
cv.put(mySQLiteHelper.COL_LASTNAME, lastName);
cv.put(mySQLiteHelper.COL_FIRSTNAME, firstName);
cv.put(mySQLiteHelper.COL_FIRSTNAME, firstName);

long id = db.insert(mySQLiteHelper.TABLE_GRADES, null, values);
```



# SQLite: delete code

- ❖ Create a public method, like deleteDb(...)
- ❖ The delete method returns the number of rows affected
- ❖ Example:

```
db.delete(mySQLiteHelper.TABLE_GRADES, "id = ?", new String[]  
{Integer.toString(id_to_delete)});
```



# SQLite: update code

## ❖ Create a public method, like updateDb(...)

```
ContentValues cv = new ContentValues();
values.put(mySQLiteHelper.FIRSTNAME, firstName);
values.put(mySQLiteHelper.LASTNAME, lastName);

db.update(mySQLiteHelper.TABLE_GRADES, values, "id = ?", new String[]
{Integer.toString(id_to_update)});
```





# SQLite: **search code**

❖ Create a public method, like `getFromDb(...)`

```
Cursor gradeCursor = db.query(mySQLiteHelper.TABLE_GRADES,  
    new String[]{mySQLiteHelper.COL_GRADE}, mySQLiteHelper.COL_ID + " = "  
    + id_to_search_for, null, null, null, null);
```



# Cursors: **data handlers**

- ❖ A Cursor stores data given by a DB query
- ❖ Some methods:
  - ❖ getCount()
  - ❖ moveTo{First,Next,Last,Position,Previous}()
  - ❖ close()
- ❖ You need to look inside the Cursor to see query's results

```
while (gradeCursor.moveToNext()) {  
    Log.v("GRADES",gradeCursor.getString(0));  
}
```



# Cursors: **methods**

## ❖ Manipulating the cursor

- `cursor.moveToFirst()`
- `while (cursor.moveToNext())`
- `for (cursor.moveToFirst(); !cursor.isAfterLast(); cursor.moveToNext())`

## ❖ Get column numbers from names

- `int nameColumn = cursor.getColumnIndex(People.NAME);`
- `int phoneColumn = cursor.getColumnIndex(People.NUMBER);`

## ❖ Get Data from column

- `String name = cursor.getString(nameColumn);`
- `String number = cursor.getString(phoneColumn);`



# Content Providers

- ❖ A system to access shared data
- ❖ Similar to a REST web service
- ❖ To each Content Provider, one or more URIs are assigned in the form:

```
content://<authority>/path
```



# To **build** a Content Provider

- ❖ Define the DB
- ❖ Create a class that extends `android.content.ContentProvider`
- ❖ Implement `query()`, `insert()`, `update()`, `delete()`
- ❖ Register the `ContentProvider` in the manifest

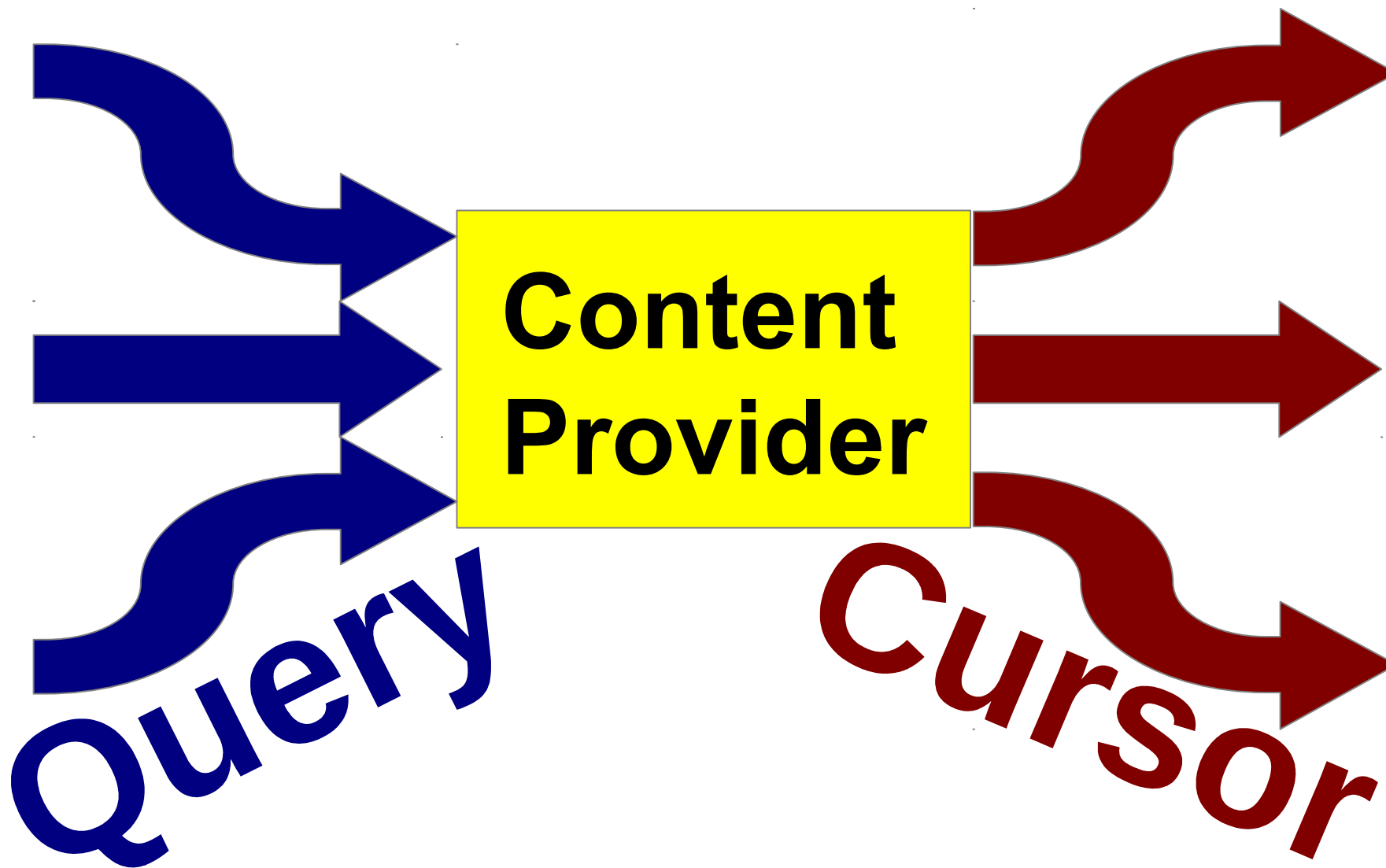


# How to **use** a Content Provider

- ❖ Need to get the URI
  - Usually this is declared as public inside the content provider class
- ❖ Make a query, maybe adding some where clauses
  - You'll get a Cursor after that
- ❖ Navigate the Cursor



# Content Providers





# Example: **contacts**

- ❖ Query the contacts content provider
- ❖ Contacts information are shared among applications
- ❖ You need to request a permission

```
<uses-permission android:name="android.permission.READ_CONTACTS"/>
```





# Contacts: code

```
public void onCreate(Bundle savedInstanceState) {  
    super.onCreate(savedInstanceState);  
    setContentView(R.layout.main);  
  
    Cursor cursor =  
        getContentResolver().query(ContactsContract.Contacts.CONTENT_  
            URI, null, null, null, null);  
    while (cursor.moveToNext()) {  
        String contactName = cursor.getString(cursor.getColumnIndex(  
            ContactsContract.Contacts.DISPLAY_NAME));  
    }  
    cursor.close();  
}
```